28*th* IUGG Conference on Mathematical Geophysics, June 7-11, 2010, Pisa, Italy
Session 3: Geophysical fluid dynamics III - Atmosphere and ocean

Internal waves in the atmosphere and oceans and explicit models of the internal tide

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Keywords: *general circulation; internal tide; climatological consequences*

Topographically forced internal waves are ubiquitous features of both the atmospheric and oceanic general circulation. In the atmosphere the breaking of such waves above high elevation topography provides the explanation of the intense downslope windstorms that occur frequently in the lee of topographic extrema. The best known examples of such events are those which occur frequently over the Rocky mountains to the west of Boulder Colorado. In the coastal oceans the same phenomenon is also a recurrent feature in circumstances in which tidally forced flow over a sill, say at the mouth of an estuary, also generates intense internal wave activity and wave breaking. The best known example in the coastal ocean is from Knight Inlet on the coast of the Canadian province of British Columbia. There, as a consequence of the existence of the overlying free surface, the phenomenon is often accompanied by the generation of intense upstream propagating solitary waves. On a global scale in the oceans the same process as operates in the coastal environment is responsible for the the generation of the so called "internal tide" that arises due to the interaction of the barotropic tide with bottom topography. Since the internal tide is responsible for a substantial fraction of tidal dissipation and is therefore heavily implicated in the evolution of the orbit of the Moon, it is a phenomenon of planetary scale relevance. Detailed analyses have been performed of the impact of the modest changes in the geometry of the ocean basins associated with the Late Quaternary ice-ages on the partition of tidal dissipation between bottom friction and the internal tide. It is demonstrated that intense resonances develop at high latitudes in both hemispheres that are expected to have extremely important climatological consequences. These are primarily associated with the excitation of gravest mode Kelvin waves at the M2 frequency.